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SELF-SEALING CONTAINER CLOSURE

The invention concerns a container closure for flexible storage containers, for example, bottles or tubes that contain products that are liquid to pasty, wherein the container closure automatically opens like a valve to discharge the product when the storage container is squeezed and is then automatically closed again by the restoring force of the storage container.

Various devices that are fundamentally different in their design and mode of operation are known for delivering liquid to pasty products by squeezing the product out of a storage container through an applicator hole.

EP 0 048 420 B1 describes an expensive device that consists of a hollow-cylindrical storage container with a dispenser head with a dispenser pump, in which downwardly directed external pressure on the dispenser pump forces the product in the storage container out of the storage container through the applicator

hole.

Since the storage containers generally are not refilled after they have been emptied but rather are thrown out, especially great importance has been attached to the simple and inexpensive production of these ``disposable product dispensers''. Therefore, dispensers with especially simple designs are known, in which the product is delivered by squeezing the storage container out of an opening of the storage container and in which, depending on the purpose and viscosity of the product, the opening of the storage container is directed downward. A simple cap, screw closure, or alignment pin is then used to open and close the opening.

Although the closures used in these types of storage containers generally operate satisfactorily, there is a need for an improved closure, which led to the development of a flexible, self-sealing delivery valve, which is mounted above the container opening. When the storage container is squeezed, this valve is opened by the increased internal pressure, and the fluid product is discharged through the valve.

A storage container closure of this type is described in DE 692 02 466 T2. It consists of a closure body that is closed

with a cover and mounted, for example, screwed onto, the neck of a storage container. A convex elastic valve with slits is centrally located in the closure body on a concave support device. When an external force is applied to the storage container, the fluid product is forced from below towards the central section of the valve, which causes the valve to bulge outward. The fluid product can then flow out through the opening slits. When the application of the external force on the container stops, the elasticity of the valve causes the valve to return to its normal relaxed, sealing position.

In addition to its expensive and complicated design with respect to its operation, this previously known container closure has the disadvantage that the negative pressure remaining in the storage container after external pressure is no longer being applied is eliminated only unsatisfactorily, if at all.

Proceeding on the basis of this prior art, the objective of the invention is to design a container closure of the type specified above with simple design and manufacture in such a way that, in addition to automatic opening and closing, complete ventilation of the storage container occurs upon completion of

the delivery process.

This objective is achieved by a dispenser of the type described above with the characterizing features of Claim 1, in accordance with which the container closure consists of a housing with a centrally arranged, axially displaceable elastic annular disk and an axially displaceable sealing plug arranged centrally below the annular disk, such that the downward axial movement of the annular disk is limited by several stop ridges, and the upward axial movement of the sealing plug is limited by at least one stop ridge.

Advantageous modifications of the invention are specified in the dependent claims.

The arrangement of an elastic annular disk on a sealing plug in accordance with the invention produces a closable delivery hole between these two sealing elements by simple means. During the delivery process, in which the product that is to be dispensed is pressed from below against the elastic annular disk by pressure on the storage container, the annular disk is lifted centrally from the sealing plug towards the outside, which opens a delivery gap between the annular disk and the sealing plug. Upon completion of the delivery process, the

annular disk drops back onto the sealing plug due to the negative pressure that now exists in the storage container and thus seals the storage container again. The elasticity of the sealing disk is adapted to the viscosity of the product that is to be dispensed and to the restoring force of the storage container to ensure complete restoration of the annular disk.

In accordance with the invention, since not only the sealing disk but also the sealing plug is designed to be axially displaceable, it is possible to achieve not only automatic opening and closing of the container closure but also the desired complete ventilation of the storage container upon completion of the delivery process, such that the sealing plug is inwardly displaced by the negative pressure that prevails in the housing of the storage container and opens a ventilation gap between the annular disk and the sealing plug. Alternate axial displacement of the annular disk and sealing plug in opposite directions thus occurs.

To make this alternate axial displacement possible, the stop ridges that limit the axial displacement of the annular disk and the sealing plug are arranged between the annular disk and the annular shoulder of the sealing plug. During the

outward axial displacement of the sealing disk during the dispensing of the product, the stop ridges prevent the sealing plug from also being displaced in the same direction, and after the product has been dispensed, they prevent the annular disk from following the inwardly displaced sealing plug. Alternatively, it is also possible for a stop ridge to be guided centrally from above onto the sealing plug through the annular disk to prevent upward displacement of the sealing plug during the dispensing of the product.

In an advantageous embodiment of the invention, the sealing plug is supported on a spring element, by which the sealing plug is pressed from below against the stop ridges and against the annular disk. The spring tension of the spring element is adjusted in such a way that the restoring force of the storage container and the negative pressure it produces are sufficient to displace the sealing plug inward against the spring tension.

Various axially acting springs can be used as spring elements, for example, helical springs or radially arranged leaf springs.

The interaction of the annular disk and sealing plug in conjunction with the stop ridges thus makes the following

positions possible:

Closed Position: In this initial position, the storage container is unpressurized; the annular disk rests against and seals the sealing plug and the stop ridges, and the sealing plug is pressed against the stop ridges from below by the spring element.

Dispensing Position: The application of external force on the storage container creates an excess pressure in the storage container; the annular disk is lifted from the sealing plug and the stop ridges by the upward pressure of the product, and the sealing plug continues to be pressed against the stop ridges from below by the spring element; the material is discharged through the gap between the annular disk and the sealing plug that has formed towards the top.

Ventilation Position: The restoring force of the storage container produces a negative pressure in the storage container; the annular disk is again resting on the stop ridges due to its elasticity, the sealing plug is displaced downward against the spring tension of the spring element, and the container is ventilated through the gap between the annular disk and the sealing plug that has formed towards the bottom. During this

process, residual product (drops) that may have been left behind is drawn back into the storage container, so that the closure remains clean. After pressure equalization has occurred, the sealing plug returns to its initial position.

Other advantages, features, and characteristics of the invention are explained in greater detail below with reference to the embodiments illustrated in the schematic drawings.

-- Figure 1 shows a container closure in a vertical section in the initial position.

-- Figure 2 shows the container closure of Figure 1 in the delivery position.

-- Figure 3 shows the container closure of Figure 1 in the ventilation position.

-- Figure 4 shows the container closure of Figure 1 installed in a possible dispenser head in a vertical section.

-- Figure 5 shows a spring element that consists of U-shaped leaf springs.

-- Figure 6 shows a spring element that consists of flat leaf springs.

-- Figure 7 shows a spring element that consists of radially bent leaf springs.

-- Figure 8 shows a top view of an alternative embodiment of a container closure installed in a possible dispenser head.

-- Figure 9 shows the container closure of Figure 8 in a vertical section.

-- Figure 10 shows an enlarged section of the container closure of Figure 9.

Figures 1, 2, and 3 show a container closure 1 of the invention in different open and closed positions resulting from the internal pressure of the storage container. The storage container itself is not shown in Figures 1 to 3.

The container closure 1 shown in Figure 1 in the initial, closed position consists of an outer annular housing 5 with stop ridges 6 arranged radially at the upper end. A sealing plug 3 is pressed from the inside (in the drawing, from below) against these stop ridges 6 by the central head 17 of a spring element with a helical spring 4. An annular shoulder 9 on the lower end of the sealing plug 3 prevents any possible further axial movement of the sealing plug towards the outside (in the drawing, upward).

An elastic annular disk 2 is located at the top on the stop ridges 6 and on the sealing plug 3. The inside diameter of the

annular disk 2 corresponds to the outside diameter of an annular groove 10 of the sealing plug 3, so that the annular disk 2 and the sealing plug 3 form a common upper surface and a tight seal.

In Figure 2, the container closure of Figure 1 is in the delivery position. Increased internal pressure in the storage container, which was produced by squeezing the storage container, pressed the product to be delivered from below against the stop ridges 6, the sealing plug 3, and the annular disk 2. Since the stop ridges 6, which are rigidly connected with the housing 5, and the sealing plug 3, which rests on the stop ridges 6, cannot respond to this product pressure, only the annular disk 2 bulges outward. This results in the formation of a delivery gap 7 between the annular disk 2 and the sealing plug 3, through which the product is discharged to the outside of the container closure 1 in the direction 11 indicated by the arrow.

Finally, in Figure 3, the container closure of Figure 1 is in the ventilation position after completion of the delivery process. The restoring force of the storage container produced a negative pressure in the interior of the storage container, so that the product was drawn back into the storage container through the delivery gap 7. Due to its elasticity, the annular

disk 2 has returned to its initial position of Figure 1 and again rests flat on the stop ridges 6. In addition, the negative pressure caused the sealing plug 3 to be drawn inward against the spring tension of the helical spring 4 of the spring element. As shown in Figure 3, this led to the formation of the ventilation gap 8 between the sealing plug 3 and the annular disk 2, which is now lying flat on the stop ridges, so that air now flows from the outside into the storage container through the ventilation gap in the direction 12 indicated by the arrow. After the pressure has equalized, the spring element then presses the sealing plug 3 back into its initial position of Figure 1.

Figure 4 shows a possible installation of a container closure 1 of the invention in the dispenser head 20 of a storage container. The dispenser head 20 consists of an outer annular housing 21 with a cover 23 that can be snapped on at the top. On the inside of the upper end of the dispenser head 20 there is an inner ring 22 with a screw thread for mounting on a correspondingly dimensioned storage container. Inside this inner ring 22 there is an annular inner chamber 24, into which the complete container closure 1 of Figure 1 is inserted. The

outer annular housing 21, the inner ring 22, and the annular inner chamber 24 are fabricated as a single piece in the illustrated embodiment.

The spring element used to press upward against the sealing plug 3 in Figures 1 to 4 consists of an outer ring 16 with a helical spring 4 mounted in it and a central head 17, which is pressed from below against the sealing plug 3 by the helical spring 4. The upper end of the helical spring 4 is attached to the central head 17, and the lower end is attached to the outer ring 16. The spring element, which consists of the spring 4, the central head 17, and the outer ring 16 thus forms a structural unit that is inserted in the housing 5 from below.

Additional examples of possible designs of a spring element that can be inserted in the container closure of the invention are illustrated in Figures 5 to 7. These spring elements also consist of an outer ring 16 with a central head 17, but here the central head 17 is not connected with the outer ring 16 by a helical spring 4 but rather by leaf springs 18, 19, 25 that run radially inward. With respect to the central head, the leaf springs 18, 19, 25 are arranged in such a way that, after the spring element has been installed, they press the central head

against the sealing plug 3 from below with compressive tension. Examples of possible embodiments are flat leaf springs 18 (Figure 6), leaf springs [19] that are bent downward in a U-shape (Figure 5), and radially bent leaf springs 25 (Figure 7).

Figures 8 to 10 show an alternative design of a container closure in accordance with the invention. Figure 8 shows a top view and Figure 9 a vertical section of a possible dispenser head 20' with a housing 21, in which the alternative container closure 1' is installed. In contrast to the design of container closure 1, in the container closure 1', the annular disk 31 and the sealing plug 30 together no longer form the upper seal of the container closure 1' in the form of a flat surface, where they can easily be damaged, but rather in this case they lie at the lower end of a funnel-shaped dispenser mouth 35 that opens upward and are thus protected inside the upper part of the container closure 1'. A pin-like stop ridge 33, which is rigidly connected with the housing 5' by three support legs 34, is arranged in the center of this funnel-shaped dispenser mouth 34. It is guided from above onto the sealing plug 30 and limits the upward axial displacement of the sealing plug 30. The sealing plug 30 is pressed from below against this pin-like stop

ridge 33 by the spring tension of a spring element 4. The annular space remaining between the sealing plug 30 and the open funnel-shaped dispenser mouth 35 is sealed by an annular disk 31, whose peripheral edge is wedged between the stop ridges 32 below and the annular wall 36 of the funnel-shaped dispenser mouth 35 above.

In Figure 10, which shows an enlarged section of Figure 9, details of this container closure 1' are shown more clearly. With the same mechanism of action as in the case of container closure 1 (cf. Figures 1 to 4), in the delivery position of container closure 1', the annular disk 31, which rests on the stop ridges 32 and the sealing plug 30, is caused to bulge outward by the excess pressure originating in the storage container. In the same way as in container closure 1, this causes a delivery gap to form between the sealing plug 30 and the annular disk 31, through which the material to be dispensed is upwardly discharged. The sealing plug 30 cannot follow the upward axial displacement of the annular disk 31, since upward axial displacement is prevented by the pin-like stop ridge 33, which is rigidly connected with the housing 5' by the support legs 34.

In the ventilation position, in which the annular disk 31 is sucked back into its initial position by the negative pressure caused by the storage container, stop ridges 32 located below the annular disk 31 prevent the annular disk 31 from now being displaced axially downward or from bulging inward. Instead, the sealing plug 30 moves axially downward against the spring tension of the spring element 4 and thus opens a ventilation gap between the sealing plug 30 and the annular disk 31, exactly the same as in the case of container closure 1, and this causes material still present in the funnel-shaped dispenser mouth 35 to be sucked back into the storage container until pressure equalization has occurred. In the unpressurized closed position that follows pressure equalization, the outer edge of the annular disk 31 then rests on the stop ridges 32, and the inner edge of the annular disk 31 rests on the sealing plug 30, while the sealing plug 30 is pressed from below against the pin-like stop ridge 33 by the spring tension of the spring element 4.

The container closure shown in the illustrated embodiments is not the only possible design of a container closure in accordance with the invention. Depending on the product and on

the storage container adapted to the product, the closure device of the invention can be varied within wide limits with respect to its dimensioning without deviating from the idea of the invention with its stated claims.

List of Reference Numbers

1, 1'	container closure
2, 31	annular disk
3, 30	sealing plug
4	spring element with helical spring
5, 5'	housing
6, 32	stop ridges
7	delivery gap
8	ventilation gap
9	annular shoulder
10	annular groove
11	delivery route
12	ventilation route
16	outer ring
17	central head
18	flat leaf spring
19	U-shaped leaf spring
20, 20'	dispenser head

21 housing

22 inner ring

23 cover

24 inner chamber

25 radially bent leaf spring

33 pin-like stop ridge

34 support legs

35 dispenser mouth

36 annular wall